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14. Health in Romano-British Urban Communities: Reflections from the Cemeteries

Rebecca Redfern and Charlotte Roberts

This research focuses upon the impact of urban living in Romano-British communities. In order to provide a new insight into this period of British archaeology, a biocultural approach to analysis was applied to evidence from palaeopathology, archaeological plant and animal remains, and primary sources.

The cemeteries used in the study dating from the 2nd to 4th centuries AD are as follows: Chichester, Ilchester, Cirencester, York, London, Colchester and Dorchester. This provides a total of 2578 adult and non-adult individuals (Table 1 and Figure 1) for study.

The study found that the communities had statistically significant levels of stress indicators (cribra orbitalia, enamel hypoplastic defects and periostitis), and that the prevalence of infectious and metabolic diseases reflected the flora and faunal picture of unhygienic living conditions. The study supported the use of the non-adult sample as a gauge for community health and levels of sanitation.

INTRODUCTION

This paper will discuss the evidence for the living environment, archaeological data, primary sources, and diet of the period with an attempt to link it with the evidence for health and disease in human remains from late Roman urban cemeteries. In particular, it will focus on non-adult health, adult stress indicators, infectious and metabolic diseases. This study was undertaken to test the following hypotheses – was living in Roman towns unhealthy? Can correlations be made between levels of health and the bioarchaeological material reflecting 'living conditions' from Romano-British urban sites? Does the infant sample reflect the health of the community? (Saunders and Barrans 1999, 184). Linking biological and cultural data (see Bush and Zvelebil 1991) has been neglected with regard to the study of human remains in Roman archaeology, whereas zoo-archaeology has made frequent use of such approaches (Dobney 2001).

The relationship between urbanism and health in physical anthropology has been investigated many times in America (for example, Steckel and Rose 2002), but has been neglected in British contexts, especially for this

particular period. Previous studies such as those by Brothwell (1994, 129–36), Manchester (1992, 8–14) and Waldron (1989, 55–73) have highlighted the range of diseases one would expect to see, but no in depth study has concentrated on this period.

Today, as in the past, the health of individuals is controlled by a number of factors, one important factor being their environment. The differences between an urban and rural environment can be seen in the transmission of infectious diseases, which are spread more easily in denser communities. In addition, the refuse generated by a population living in densely settled areas, which also contain industrial works can contaminate water supplies, and migrants into the area can act as agents of disease. As food would have been sourced from the surrounding areas, fluctuations in quantity would have affected the urban dwellers (Storey 1992, 33), which may have led to periods of stress, and the development of metabolic diseases. The types of building and spaces within towns, for example: bathhouses and markets, may have acted as influential vectors of disease. Indeed, "many factors related to urban living enhance infection by



Figure 1. Map of Roman Britain (after Jones and Mattingly 1990, 154. Drawn by V.Glue).

increasing contact with pathogens ... urban populations provided ideal living conditions for the continued survival and transmission of pathogens" (McGrath 1992, 16).

This paper will outline the materials and methods employed in this study, the results of the study, and a discussion of the results in relation to the evidence.

MATERIALS AND METHODS

This investigation has two interpretational problems that should be highlighted from the outset. Firstly, the cemeteries were used for long periods of time, and therefore the information regarding health from these samples represents the whole of the Roman occupation. Secondly, who were the people living in towns, and where did they come from? Unfortunately, this cannot be answered unless ancient DNA and isotopic analyses are undertaken on the major cemeteries of Roman Britain.

The archaeological contexts of the remains used in this study are outlined below, and date to the 2nd–4th centuries AD (Figure 1):

1. **London** – St Bartholomew's Hospital (Bentley and Pritchard 1982), West Tenter Street (Waldron 1984), Watling Street (White 2000), Hooper Street (Lee unpublished report), The Three Lords (Waldron 1985), St Clare's Street (Waldron 1983) and Haydon Street (Keily 1988). Total number of individuals = 285.
2. **Dorchester** – The Poundbury Camp cemetery (Farwell and Molleson 1993). Total number of individuals = 618.
3. **York** – Castle Yard (Ramm 1957) and Trentholme Drive (Warwick 1968). Total number of individuals = 508.
4. **Colchester** – Butt Road Site (Pinter-Bellows 1995). Total number of individuals = 606.
5. **Chichester** – St Pancras Cemetery and Theological College (Foden 1993). Total number of individuals = 54.
6. **Ichester** – Little Spittle and Townsend Close (Everton and Rogers 1982). Total number of individuals = 60.
7. **Cirencester** – North and south of the Fosse Way (Wells 1982). Total number of individuals = 447.

Table 1. Infant data.

Cemetery	No osseous change	Periostitis	Cribra Orbitalia	Enamel Hypoplastic Defects	Infectious disease	Fractures	Trauma (Surgery)
London	52.7% [19/36]				2.8% [1/36]		
Ilchester	83.3% [5/6]						
Chichester	100% [1/1]						
Colchester	63.9% [23/36]		2.8% [1/36]	2.8% [1/36]			
Poundbury Camp	2% [1/50]	84% [42/50]	2% [1/50]			4% [2/50]	2% [1/50]
Cirencester	63.3% [19/30]		3.3% [1/30]				
York	100% [18/18]						

These cemeteries were chosen as they have been accepted by scholarship to be urban centres during the Roman occupation, and are fully published (or available). Although it must be considered that many of the individuals buried in the urban cemeteries had migrated from rural areas.

Several types of human remains were excluded from the analysis. Cremated human bone was excluded due to the disparities of publication and analysis, including the identification of palaeopathology (see McKinley 2000a, 413). Also disarticulated remains, due either to a lack of analysis within the reports, unclear contexts or because the total numbers of individuals from the sites did not include these remains.

The data was collected from information published in the microfiche, (where this was included in the site report), or from the specialist report. The London data set was sourced directly from the Museum of London Archaeology Service Archive (White pers. comm). The inter-observer error in this study is quite clear due to publication disparities and the different authorship of the reports. Therefore, in order to be able to use the data, the information was separated using the age categories used by behavioral biologists, described by Scheuer and Black (2000, 469). All information regarding osteological change was categorised according to Aufderheide and Rodríguez-Martín (1998). This was done in order to demonstrate the range of changes, as well as the palaeopathology found for this period. However, periostitis was further subdivided from infectious disease in order to analyse the evidence for stress indicators (cribra orbitalia, periostitis and enamel hypoplastic defects) in the different age and sex categories. Evidence for decapitation was not included in the study, as it was not clear whether this represented a burial rite (Harman *et al.* 1981), or perimortem trauma. Current research by the author has permitted the re-analysis of some of the skeletons included in this study (Poundbury Camp), which has altered the diagnosis of some osteological changes.

Chi square tests (degrees of freedom = 5%) were undertaken on the prevalence of stress indicators in the adult samples. This is the only disease category to be tested, as it had a suitable number of individuals.

The discussion will concentrate upon non-adult, male/

probable male, and female/ probable female evidence for infectious and metabolic disease, neoplasms, and indicators of stress, as well as trauma, surgery and fractures, this is in order to assess who received medical care, and the role of infants as gauges of a community's health. This method was undertaken in order to conduct focused research, and to limit the impact of inter-observer error upon interpretation. The figures shown in the Tables are crude prevalence rate data summaries, consequently some categories are absent and therefore not all cumulatively reach 100%.

RESULTS

Infants (0–3 years) [Table 1] – The highest number of individuals from six of the cemeteries did not have any osseous changes recorded on their skeleton. Poundbury Camp had the lowest prevalence. The low prevalence of stress indicators in the age group demonstrated that no cemetery has individuals presenting all three indicators. The prevalence of infectious disease is very low in the age group, and was only found at London, where one individual was recorded. The Poundbury Camp cemetery is the only site where evidence for fractures in this age group was found; two individuals had fractured two elements. It is also the only site where evidence for trauma was found in one individual, this has been interpreted to indicate abortion (Farwell and Molleson 1993, 152).

Children (3–6 years) [Table 2] – Individuals who did not demonstrate an osteological response, frequently represented the total sample for this age group at many cemeteries, for example at Ilchester and Chichester.

The prevalence of stress indicators often varied between sites. It is only at London that similar rates of enamel hypoplastic defects and cribra orbitalia are seen, and individuals who display all three stress indicators. At Colchester, only one individual had enamel hypoplastic defects, but the highest numbers of individuals with cribra orbitalia were recorded. Cirencester had the lowest prevalence.

The prevalence of infectious disease is very low in this age group, as only one individual from London was recorded as having changes associated with these di-

Table 2. Child data.

Cemetery	No osseous change	Periostitis	Cribra Orbitalia	Enamel Hypoplastic Defects	Infectious disease	Metabolic disease
London	66.6% [10/15]					
Ilchester	100% [2/2]					
Chichester	100% [1/1]					
Colchester	88.6% [39/44]					
Cirencester	94.5% [17/18]		5.5% [1/18]			

Table 3. Juvenile data.

Cemetery	No osseous change	Periostitis	Cribra Orbitalia	Infectious disease	Metabolic disease	Fractures
London	71.4% [15/21]				4.8% [1/21]	
Chichester	100% [3/3]					
Colchester	67.8% [19/28]		21.4% [6/28]			
Poundbury Camp	32.9% [27/82]	23.2% [19/82]	2.4% [2/82]	2.4% [2/82]	12.2% [10/82]	1.2% [1/82]
Cirencester	76.9% [10/13]		30.8% [4/13]			
York	42.8% [6/14]					

Table 4. Adolescent data.

Cemetery	No osseous change	Periostitis	Cribra Orbitalia	Enamel Hypoplastic Defects	Surgery	Fractures
London	63.6% [14/22]		9.1% [2/22]	9.1% [2/22]		
Ilchester	100% [3/3]					
Colchester	84.6% [11/13]		7.7% [1/13]	7.7% [1/13]		7.7% [1/13]
Cirencester	30.4% [7/23]	4.3% [1/23]		26.1% [6/23]		4.3% [1/23]
York	92.7% [38/41]				2.4% [1/41]	

seases. London is also the only site where two individuals have changes corresponding to metabolic disease.

Juveniles (7–11 years) [Table 3] – The highest number of individuals from the sub-sample lacked an osteological response, for example at Chichester. The prevalence of stress indicators is low, as only three cemeteries recorded these osseous changes. No enamel hypoplastic defects were recorded for this age group, and it is only at the Poundbury Camp where individuals have both periostitis and cribra orbitalia. The prevalence of infectious disease is also low, and is only represented by two individuals from the Poundbury Camp. In this age group, the prevalence of metabolic disease is higher than that of infectious disease, and is only indicated in ten individuals at Poundbury Camp, and one individual at London. Poundbury Camp has the only evidence for fractures in

Adolescents (12–18 years) [Table 4] – The highest number of individuals lacked an osseous response, and at Ilchester, this accounted for all the individuals. This age group had the lowest prevalence of stress indicators. No cemetery had individuals displaying all three, but unlike the juvenile sample, this group showed evidence of enamel hypoplastic defects. The indicators have not been recorded at all cemeteries. The only example of surgical intervention (trepanation) was recorded in one individual from York. The presence of fractures was found in two individuals from Colchester and Cirencester.

Males/probable males [Table 5] – The number of individuals with no osseous response varies between the cemeteries, and is lower than the non-adult samples. The prevalence of stress indicators in this group is low, with some cemeteries only having one individual suffering

Table 5. Male and probable male data (*italics* = probable male).

Cemetery	No osseous change	Periostitis	Cribra Orbitalia	Enamel Hypoplastic Defects	Infectious disease (includes osteomyelitis)	Fractures
London	14.6% [14/96]	9.4% [9/96]	3.1% [3/96]	18.7% [18/96]		15.6% [15/96]
	<i>23.5%</i> <i>[14/17]</i>	<i>5.9%</i> <i>[1/17]</i>	<i>5.9%</i> <i>[1/17]</i>	<i>11.8%</i> <i>[2/17]</i>		
Ilchester	36% [10/28]					3.6% [1/28]
Chichester	73.7% [14/19]	3.5% [6/171]	3.5% [6/171]			5.3% [1/19]
	<i>33.3%</i> <i>[3/9]</i>	<i>11.1%</i> <i>[1/9]</i>				<i>11.1%</i> <i>[1/9]</i>
Colchester	28.6% [49/171]	3.5% [6/171]	3.5% [6/171]	17.5% [30/171]	1.2% [2/171]	9.4% [16/171]
	<i>50%</i> <i>[3/6]</i>	<i>16.7%</i> <i>[1/6]</i>			<i>16.7%</i> <i>[1/6]</i>	
Poundbury Camp	1.6% [4/251]	11.5% [29/251]	0.4% [1/251]		0.4% [1/251]	28.3% [71/251]
Cirencester	16.4% [16/220]	6.8% [15/220]	4.1% [9/220]	9.5% [21/220]	0.9% [2/220]	24.5% [54/220]
	<i>66.7%</i> <i>[6/9]</i>			<i>11.1%</i> <i>[1/9]</i>		
York	47.9% [149/311]	1% [3/311]	0.3% [1/311]	0.3% [1/311]	0.3% [1/311]	4.5% [14/311]
	<i>61.9%</i> <i>[13/21]</i>					

from cribra orbitalia. Nevertheless, at most cemeteries, all three stress indicators are present. A chi-square test proved that the prevalence was statistically significant. Only two cemeteries have individuals with evidence of specific infectious disease. Osteomyelitis was seen in three individuals, and was separated out in order to distinguish long-term infection.

Evidence for medical treatment was found at Cirencester, where an individual had a trepanation performed on his frontal element, after suffering sharp weapon trauma to his cranium. An individual from Chichester may represent possible evidence for dental surgery, as two molars could have been removed.

Two individuals demonstrated evidence of neoplastic change; one individual from Poundbury Camp had changes which were diagnosed as metastatic carcinoma (Farwell and Molleson 1993, 196). The other case was from York, where an individual had a neoplasm on his mandible (No. 38. Warwick 1968, Plate XLIX). Fractures were recorded from all the cemeteries, with Ilchester and Chichester having the lowest prevalence.

Females/probable females [Table 6] – The number of individuals without an osseous response are lower than the male sample. At many of the sites, such as Ilchester and Chichester most of the female samples are in this category. The prevalence of stress indicators is lower than the non-adult and male groups, however, a chi-squared test proved that it was as statistically significant. This group had the highest prevalence of infectious disease and osteomyelitis. At the Poundbury Camp, a case of tuberculosis was diagnosed macroscopically and radiographically using the following changes: kyphosis, new bone formation, partial collapse of the spinal column and destruction of the disc plates (Farwell and Molleson 1993, 190). Metabolic disease was recorded at four cemeteries, and the highest prevalence was found at Poundbury Camp, where thirty-one females had metabolic changes. Neoplastic changes were seen in one individual from Poundbury Camp who had changes associated with myelomatosis (Farwell and Molleson 1993, 196–7). The highest prevalence for inter-personal trauma was seen at Cirencester, London and Poundbury Camp. London and

Table 6. Female and probable female data (*italics* = probable female).

Cemetery	No osseous change	Periostitis	Cribra Orbitalia	Enamel Hypoplastic Defects	Infectious disease (includes osteomyelitis)	Metabolic disease	Fractures
London	13.8% [5/36]	13.8% [5/36]	2.7% [1/36]	19.4% [4/36]	11.1% [4/36]	8.3% [3/36]	16.7% [6/36]
	<i>66.6%</i> <i>[8/12]</i>		<i>8.3%</i> <i>[1/12]</i>	<i>41.6%</i> <i>[5/12]</i>	<i>66.7%</i> <i>[8/12]</i>	<i>8.3%</i> <i>[1/12]</i>	<i>15.4%</i> <i>[2/13]</i>
Ilchester	100% [2/2]						
	<i>38.5%</i> <i>[5/13]</i>						<i>15.4%</i> <i>[2/13]</i>
Chichester	91.7% [11/12]						
Colchester	25.6% [33/129]		5.4% [7/129]	19.4% [25/129]	1.5% [2/129]	0.7% [1/129]	5.4% [7/129]
	<i>47%</i> <i>[8/17]</i>	<i>11.8%</i> <i>[2/17]</i>		<i>5.9%</i> <i>[1/17]</i>			
Poundbury Camp	1.8% [4/226]	8% [18/226]			1.8% [4/226]	13.7% [31/226]	19.5% [44/226]
Cirencester	12.8% [10/78]	6.4% [5/78]	1.3% [1/78]	10.2% [8/78]	2.6% [2/78]		9% [7/78]
	<i>33.3%</i> <i>[5/15]</i>	<i>13.3%</i> <i>[2/15]</i>					
York	76.2% [32/42]						2.4% [1/42]
	<i>61.9%</i> <i>[13/21]</i>					<i>4.8%</i> <i>[1/21]</i>	

Poundbury Camp were also the cemeteries with the highest prevalence of fractures.

DISCUSSION

Bioarchaeological evidence is key to understanding Romano-British urban environments, and therefore should be outlined before the interpretation of the dataset. We are reliant upon the bioarchaeological data to build a picture of these urban environments, because we lack primary sources describing the living conditions in British towns (unlike Rome, see Scobie 1986). The majority of organic deposits providing relevant evidence have been excavated in York and London. However, charred plant material has been located at other sites such as at Colchester (Dobney *et al.* 1999, 17–18).

LIVING ENVIRONMENT

The environmental evidence provides a more detailed insight into the reality of Roman urban living. Dobney *et al.*'s. (1999) review of the environmental evidence from

coloniae in Roman Britain concluded that relatively little had been recovered, and therefore a detailed study is still required. Evidence, however, points to clean and dry areas, but this does not necessarily imply cleanliness. Furthermore, the data often derives from military contexts. Settlements have also been characterised by a group of environmental indicators which have been interpreted to show evidence of squalid areas, rotting material, food remains, faecal material and insects such as fleas, lice and woodworm. Whether this settlement evidence can be used in civilian contexts is debatable (Hall and Kenward 1995, 393). However, recent research into the nature of the military force in Britain demonstrates that the military and civilian divisions were blurred. There is no current evidence suggesting that civilians were prohibited from entering and living in or near fortresses (James 2001, 83–4), so the overall view may be applicable.

Excavations at One Poultry in London have provided a unique insight into domestic living conditions. This site lies at the centre of London, and consists of what was part of the inhabited western bank of the Walbrook stream; Roman timber homes, shops, out buildings, as well as bioarchaeological data were well preserved (Rowsome 2000, 6–19). Analysis of the timber buildings



Figure 2. Reconstruction of a Romano-British urban area (after Rowsome 2000, 41. Drawn by V. Glue).

and their surrounding plots have shown that the yards contained dumps of household rubbish, in addition to being used to keep pigs and chickens. If the water source utilised by the inhabitants was located near to the animals, then the source could become contaminated. Wells were also dug into these plots, providing excellent habitats for pathogens of cholera and dysentery (Roberts and Manchester 1999; Larsen 1999, 38). Houses provided shelter for house mice and black rats, which can be carriers of typhus (Rowsome 2000, 34 and Oxford Concise Medical Dictionary 2000, 680). Latrines were found excavated into kitchen areas, and open drains running between the plots carried waste from these buildings, in addition to those from nearby industrial projects (Rowsome 2000, 30–5) (Figure 2).

Evidence for the continuity of typical Iron Age circular buildings in the Roman period has been found in many urban centres. This means that some individuals could have been exposed to many pathogens and pollutants that many individuals living in the new 'Roman' style houses (Walthew 1975) would not have been exposed to. For example, poor ventilation in round houses could

predispose individuals to respiratory diseases (Roberts and Manchester 1999, 131), such as asthma (Oxford Concise Medical Dictionary 2000, 89).

LOCAL LIVING CONDITIONS AND HEALTH

Parasitic remains provide evidence for personal hygiene and living conditions – for example, a crab louse was found at Carlisle (Kenward 1999, 192). Hair lice have also been found at Poundbury Camp, where many individuals still had them attached to their hair (Farwell and Molleson 1993, 178. See plate 49). Whipworms and roundworms have also been noted in faecal deposits. Pelvic cavity soil samples from individuals buried at Poundbury Camp indicated that all ages and both sexes were affected (Jones 1993, 197–8). The occurrence of these parasites demonstrates that people had poor levels of personal hygiene and were more likely to be living in cramped conditions. This allowed the droplet spread of infectious diseases (Rheinhard 1992, 238). The infestation of parasites may explain the prevalence of indicators of

metabolic disease, especially cribra orbitalia. The low prevalence of this change in both men and women indicates that their diet was sufficient in iron, or that their parasite load was not leading to a deficient status (Holland and O'Brien 1997). This shows continuity from the adolescent samples, which have very low frequencies of cribra orbitalia indicating that some of the lesions were healing or had healed before adulthood was attained. The interpretation of adult lesions is problematic, as Stuart-Macadam (1991, 101 and 106) in her analysis of the Poundbury Camp material, concluded that cribra orbitalia was more likely due to an acquired anaemia, and reflective of childhood levels of non-specific infections. The female samples have a lower prevalence compared to the male, and therefore the lesions may represent those acquired during their life e.g. pregnancy or those who were able to adapt to their environment (Robledo *et al.* 1995, 190–1).

The unhealthy nature of the urban environment, as suggested by the bioarchaeological data, may be reflected in the stress indicators, and lack of osseous response present in some individuals. The statistical significance of male and female rates demonstrates that urban living may have been detrimental to health. This supports Goodman *et al.* (1988) who also found a relationship between general living conditions and the occurrence of enamel hypoplasia (cited in Goodman and Rose 1991, 283). In all the non-adult age categories, individuals without osseous changes made up the majority of the sample; the older non-adults (juveniles and adolescents) also indicate a stressful environment, and the osseous changes that it caused i.e. stress indicators and anaemia. It is suggested that this indicates an unhealthy urban environment, with high levels of exposure to infectious disease (the primary factor in childhood mortality, see Saunders and Hoppa 1993, 134), which resulted in few individuals surviving, as their ability to counter disease had been affected since birth. However, the individuals with stress indicators support Schell's assertion that, "the study of people's biological reactions to features of urban environments exposes an action of culture" (1997, 67). This approach is especially useful if urbanism is taken to be a cultural action through Romanization.

The role of migration within the Empire cannot be underestimated as a cause of stress in some individuals, particularly for people moving from rural environments. This is supported by modern anthropological and clinical research, which has shown that there is higher physical and mental morbidity in towns (Harrison 1980, 61). Following migration, there may be a change in socio-economic levels which may cause stress, thereby lowering cortisol levels. This is connected to a significantly lower immunity and a statistically significant increase in the frequency of illness (Bogin 1999, 395). The role of migration may have influenced the prevalence of enamel hypoplastic defects, as they may reflect travel from other parts of the Empire during childhood, and the survival of

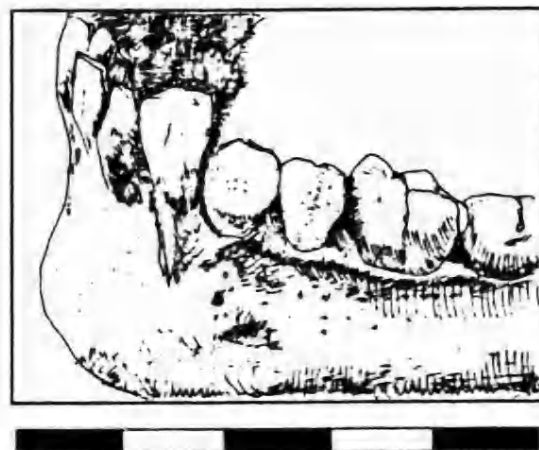


Figure 3. Enamel hypoplastic defects in the mandibular pre-molars and molars (Author's image. Drawn by V. Glue).

the (possible) subsequent stress (as supported by epigraphic evidence and isotopic analysis – see Birley 1979, Richards *et al.* 1998) (Figure 3).

The exposure to infectious diseases would have occurred in the local environment, for instance during possible employment in industries such as tanning and fulling. The differences between males and females may be explained in terms of female enhanced immune status allowing them to sustain infections for longer, therefore increasing the female prevalence (Ortner 1998, 80, 89). The number of individuals with a specific infection was less than those suffering from periostitis, and represented those who were able to sustain a serious infection for a long period of time. The development of osteomyelitis may have been the result of living in squalid conditions, such as exposure to a dirty environment, as those seen in York and London, or due to an infection subsequent to trauma. This is shown in a male from Poundbury Camp, who had osteomyelitis in his femur. This resulted in a draining sinus and stunted growth in the bone (Farwell and Molleson 1993, 195) (Figures 4a and 4b). The higher levels of periostitis within the male sample is believed to reflect the assertion that they are related to factors that are unique (Larsen 1999, 92), for example, the effect of the military way of life upon the individual, where excessive exercise can potentially cause periosteal lesions (Hackney 1994, 1356–9). The prevalence could also reflect different employment undertaken by men in the Romano-British period.

The dense occupation and poor living conditions experienced by many urban dwellers (i.e. One Poultry in London), may be reflected by the prevalence of tuberculosis at Poundbury Camp. Farwell and Molleson suggest that it was present in two or three "suspected cases" (1993, 190). It is suggested that if modern clinical and palaeopathological criteria were applied to the samples, more cases would be identified (see Roberts *et al.* 1998

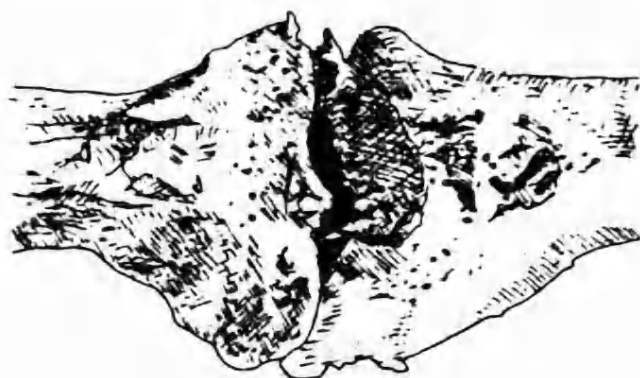


Figure 4a

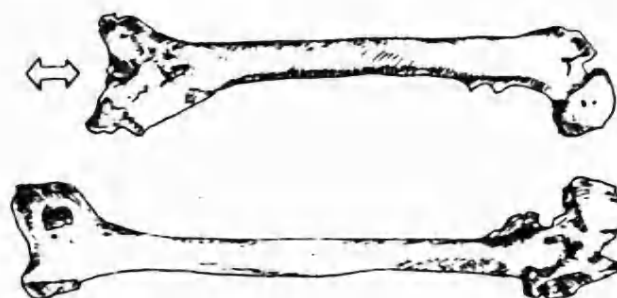


Figure 4b

Figures 4a and 4b. Osteomyelitic femur from Poundbury (based on author's image. Not drawn to scale. Drawn by V.Glue).

and Pálfi *et al.* 1999). A re-appraisal of these cases by the author demonstrates that at least one case has the distinct changes associated with tuberculosis (Pálfi *et al.* 1999), and one case has active periosteal rib lesions (it is considered that aDNA work needs to be undertaken to determine the transmitter). The transmitter of tuberculosis (human or bovine) can only be identified using bacteriological or genetic methods. Recent DNA analytical work has shown that *Mycobacterium tuberculosis* did not evolve from *Mycobacterium bovis*, indicating that tuberculosis was already a human pathogen before separation of *Mycobacterium bovis*, and *Mycobacterium tuberculosis* lineage (Vincent and Perez 1999, 139 and Brosch *et al.* 2002). Therefore, the transmission of tuberculosis at Poundbury Camp may have been via the bacilli in an infected individual's breath, sputum and other excreta, or via the close association between animals and humans dwelling in urban areas (Roberts and Manchester 1999, 137 and Vincent and Perez 1999, 140). These settings are attested in urban centres, and therefore show that within the living population the prevalence would have been higher (Roberts 2000, 151). Recent aDNA work has shown that tuberculosis was present in Iron Age Dorset, although the aDNA was unable to determine whether the transmitter was bovine or human (Mays and Taylor pers. comm), therefore it could have been present/ sustained within the Durotrigian community into the Roman period. The rural Romano-British cemetery of Tolpuddle Ball (Dorset) included a man with spinal changes indicative of tuberculosis, and a female with periosteal new bone formation on the visceral surface of her ribs, which is an indicator of tuberculosis (Roberts *et al.* 1998; Kelley and Micozzi 1984; McKinley 1999a, 167–8 and McKinley 1999b, 5–6). Therefore, it is possible that these individuals may have acted as vectors of disease in Dorchester; they may have been infected in town, or may reflect the community of tuberculosis in rural populations.

The range of employment available in urban areas

differs from rural areas, as activities that are more industrial occur due to trade etc. (Adkins and Adkins 1998). The close proximity of housing to the presence of heavy industries (e.g. smelting) at Walbrook in London (Hall and Swain 2000, 8), may have provided the 'right' exposure for certain individuals to develop neoplasms, as seen in the two individuals in the sample (Aufderheide and Rodríguez-Martín 1998, 373).

The dense settlement of urban areas is reflected in an individual from London, who displayed rachitic changes in their lower limbs. The identification of this disease is important, because it is believed to be indicative of urbanism (Roberts and Manchester 1999, 174).

DIET AND HEALTH

Diet is an important factor in maintaining a strong immune system and resistance to disease. A diet deficient in certain minerals and vitamins will leave skeletal markers that are indicative of scurvy, rickets and anaemia (Brickley 2000, 183–98; Larsen 1999, 61; Roberts and Manchester 1999, 163–75). Limited isotopic analyses have been undertaken at Poundbury Camp to reconstruct diet, and results have shown that it included a large proportion of marine resources (Richards *et al.* 1998, 1247–52). Most other studies have relied upon more traditional methods. King's study (1984, 193) of the dietary habits of Roman Britain using faunal material showed that people had a similar diet – regardless of spatial distinctions – with the emphasis upon cattle as a meat source. Dobney *et al.* (1999, 22) suggested that it may be a consequence of their economy. Evidence from York showed that people were probably also eating dormouse, hare, domestic fowl, and goose. In addition to a variety of seafood such as herring, cod, haddock, oysters and crab (O'Connor 1988, 116–23). Military personnel also ate food sent by their families, such as olives and plums. In addition, they had access to *pannis militaris*, a

bread that was rich in vitamin B and minerals (Davies 1971, 126, 132 and Jackson 2000, 39), which reduced the risk of metabolic diseases, such as anaemia (Oxford Concise Medical Dictionary 2000, 703). Nevertheless, socio-economic status and individual access to resources is unclear, and therefore not all may have had access to the wide range of foods.

What is clear from the osteological evidence is that some individuals did not have an adequate diet. A child from London displayed osteological changes associated with scurvy, indicating that the individual did not have a balanced diet (Hooper Street No. 1682). This may have been due to economic or socio-cultural reasons. This may also be true of a juvenile from London with rachitic changes in the lower limbs (Watling Street Burial 26). The prevalence of this disease may have been higher in the living community than suggested by the skeletal manifestations. Slight deformities in non-adulthood could be subsequently remodelled, obliterating their presence (Roberts and Manchester 1999, 175).

In the female sample, possible evidence of metabolic deficiencies in non-adulthood are present. For example, a female from Poundbury Camp displayed bowed tibiae and femora (Farwell and Molleson 1993, 184). The role of male preferential treatment within the Empire is well attested (Adkins and Adkins 1998, 339). However, as Roman Law was interpreted locally (Allason-Jones 1989, 15, 19), a case could be made to suggest that women had equal access to food, and therefore the reasons for both sexes developing metabolic diseases could have been the same or similar (in a civilian context).

Deficiencies of nutrients can also be linked with evidence for trauma. A male from London had suffered from an un-united Parry fracture, which would have compromised the use of his lower arm, as no pseudo-joint appears to have formed. The lack of union may have been caused by vitamin D and/or C deficiencies, as the body would be lacking the necessary levels of calcium and collagen to facilitate bone regeneration (Lovell 1997, 147; Oxford Concise Medical Dictionary 2000, 703).

What is interesting is that the evidence is dominated by the sample from London, perhaps reflecting the densely populated, international trade centre that it was, and its status as the largest urban area in Roman-Britain (Esmonde Cleary 1987, 114; Millett 1997, 65).

MEDICAL TREATMENT

It is difficult to appreciate the level of care and services provided for urban populations for this period, when the majority of texts and evidence pertain to elsewhere in the Empire. This is further complicated by the variations in medical practice performed, and instruments used by the Army stationed in Britain (Baker 2001, 49); Baker has shown that Roman medical tools do not necessarily indicate the practice of Romano-style medicine, as the

medical tools will reflect a particular military unit, and their perceptions of the body and medicine (2001, 55, 57–63). However, as stated earlier, the civilian and military mixture in urban centres may have allowed civilians to access military services such as doctors, surgeons, and bathhouses.

Roman urban centres are often characterised by bathhouses, and these were also frequently built in military forts (de la Bédoyère 1991, 59–60). Civilians had access to both, which symbolizes the practice of Romanization (Allason-Jones 1989, 143–4). Jackson (1999, 107–9; 2000, 32–3) has demonstrated that they were centres of health-care for many people and taking the 'waters' was indicated as a treatment for many diseases in the Hippocratic literature. 'Plain' water could be used to restore the humoral system, cure fatigue, swollen joints, headaches and eye complaints (Jackson 1999, 108–9). The mass appeal of bathing was perhaps due to the belief of its preventative value. However, Celsus (1935. Cited in Fagan 2001, 182) noted that bathing with a fresh wound would result in gangrene.

Surgical intervention was also found in the urban cemeteries. An adolescent from York had a healing trepanation (Warwick 1968, Plate XXVIIIb) that had been performed using the scraping technique – which had been used before the Roman invasion (McKinley 2000b, 29). However, from the Railway cemetery at York (not included in this study), a female had had a drilled trepanation performed on her left mastoid region, but there were no signs of healing (Brothwell 1974, 209–10). The presence of two different types of treatment indicates that Roman surgical modiolus was being used in Britain. At Cirencester, a male had suffered from a sword cut to the head that resulted in a radiating and depressed fracture. The man was trepanned using the scraping method which would have ensured, if superficial, that any possible haematomas and infected tissue were removed. This procedure was successful; the surrounding bone shows evidence of healing (Wells 1982, 170. Plate 36; Boylston 2000, 367) (Figure 5).

A possible case of dentistry may be present at Chichester, where a male had his mandibular right second molar and first left molar missing (Foden 1993, 93, Plate 12a and 12b, and Plate 13). Foden (1993, 93) suggests that this was due to the extraction of the teeth, as a root tip had been left in the second molar crypt, but the teeth may be absent as a consequence of associated dental disease. There was no evidence for associated inflammation or infection, perhaps because it had completely healed at the time death, or the ante-mortem loss had not resulted in infection (O'Connell and Brothwell pers. comm).

Evidence for possible treatment comes from Cirencester, where a large exostosis on the anterior border of a right tibia may have been treated, or protected by a metal plate, evidenced by metal staining on the bone proximal to the lesion (Wells 1982, B07) (although it



Figure 5. Example of a trepanation following cranial trauma from Cirencester (after Wells 1982, 170. Plate 36. Drawn by V. Glue).

may have resulted from grave goods). Similar treatment has been found at Vrasene in Belgium (Later Medieval period) Varnham in Sweden (later Medieval period), Reading (Anglo-Saxon period) (Janssens 1987), and York (later Medieval period) (Knüsel *et al.* 1995). In all cases, the affected element was encased in a copper 'bandage' (Janssens 1987, 15–6; Knüsel *et al.* 1995). This treatment was also advocated by Celsus (1935, II.5.1.2), as it was believed to disinfected the wound, and copper is known for its antiseptic properties (Janssens 1987, 16). The Cirencester case may show the use of medical services located in urban areas, thereby indicating that people living in, or close to, these centres had access to medical treatment; it also reflects the care received by the military personnel (see Baker 2001).

THE GAUGE OF THE COMMUNITY

Infant health can be used as a measure for the social and sanitary conditions of a community (Saunders and Barrans 1999, 184; Goodman and Armelagos 1989, 239). The majority of the infant sample from a cemetery site forms part of the 'frailer' members of a community, who have an increased risk of morbidity and are more likely to die before any osseous changes occur (Wood *et al.* 1992). It is postulated that many may have died from infantile diarrhoea caused by unhygienic, squalid conditions, or poor carer hygiene (Mata 1983, 4–6; Bradley-Sack 1983, 60). Medical anthropology has demonstrated infantile diarrhoea may account for 30% of infant deaths in developing countries today (Mata 1983, 15). This is of particular importance in urban environments, as Schell's (1997) research has shown. He concludes that during the gestational period and for newcomers to these areas, the urban environment can create stressors which culture

cannot buffer against. These include materials which create challenges to survival and adaptation, as well as exposure to toxic materials and infectious agents (1997, 67–8). For instance, the new buildings, resources and employment provided by the Romanization of Britain would likely have affected the parents of these children. They may, for example, have been exposed to pollutants involved in tanning or smelting. The new buildings that they may have lived in could have been similar to One Poultry in London. They may also have been employed in a bathhouse exposing them to unclean water and sick people seeking a cure.

Mothers may pass infections, such as rubella during pregnancy or via breast milk (Hall and Peckham 1997, 17), and exposure to contaminated water through bathing and weaning also presents a risk (Mata 1983, 8). The Romans recommended withholding colostrum from the newborn (Holman 1998, 7–8), and this would have affected their early immunological development, thus compromising their immune response to infections (Rao and Rajpathak 1992, 1536; Mata 1983, 7). The use of multiple wet nurses, which was believed to ensure the safety of the infant (Soranus 1991, 94), in fact increased their exposure to infections, as they could develop deafness, pneumonitis or autoimmune diseases after birth, or several years later (Hall and Peckham 1997, 19). The main problem with understanding infant nursing in the Roman period is that, "there is no evidence that ... nurses and mothers routinely and intentionally withheld milk from newborns to any degree that would impair their health. All that we have are texts adamantly instructing them to do precisely this" (Holman 1998, 8).

Many of the infants in a cemetery may also represent individuals who were stillborn, or were incompatible with life due to soft tissue defects (Barnes 1994, 5). It is not known whether the neo-natal line was detected in the dentition, as the presence of this line indicates that the individual had survived for a short time after birth (Saunders and Barrans 1999, 186). Unless this line is detected, we cannot form interpretations, or suggest, as others have done, that these individuals were the victims of infanticide. If the line was found in individuals who have been recovered from contexts suggesting that they were victims of infanticide (i.e. Ashkelon. Faerman *et al.* 1998), it can be used to hypothesize that individuals were selected for infanticide. Recent ancient DNA analytical work by Mays and Faerman on the sex ratios of full term infants from Romano-British sites concluded that the results did not statistically differ from the natural ratio, which favours males by a ratio of 1.46:1 (2001, 555–8). This corroborates research showing that males are more sensitive to environmental stressors (Stinson 1985).

Goodman and Armelagos (1989, 2270), amongst others, have noted that infant mortality is also associated with the age of weaning. This is reflected in the results obtained at London and Cirencester, where most indiv-

iduals did not display an osseous response. The influence of weaning upon mortality cannot be investigated unless the qualities of food and water, as well as the local and wider environment, are understood (Katzenberg *et al.* 1996, 180). This is most important when the 'weanling's dilemma' is seen to be one where the infant is confronted with foods contaminated by diarrhoeal pathogens, and poor hygiene (Katzenberg *et al.* 1996, 180). The seriousness of this 'dilemma' is illustrated in clinical examples; one study demonstrated that infants who had been weaned onto water and liquid foods had a very high risk of diarrhoea, whereas those who still had breast-milk in their diet had shorter bouts of illness and a decreased risk of infection (Brown *et al.* 1989, 38–9).

Weanlings were also at risk from developing iron-deficiency, due to the use of cereals in weaning food. Cereals contain phytates which are inhibitors of iron; when insufficient iron levels are reached, the level of immunity will decrease (Ryan 1997, 26, 51), as the infants are not able to receive iron and IgA antibodies from the mother (King and Uliaszek 1999, 168). Therefore, the individual may be affected by an infectious disease with which they would not be able to cope, due to their anaemic status (King and Uliaszek 1999, 167). However, many believe that mild anaemia is an adaptative strategy, as it inhibits bacterial growth (Ryan 1997, 51).

The presence of anaemia is evidenced in this sample, by the development of stress indicators, as well as infectious and metabolic diseases (Lewis 2000, 50–1; Ortner and Mays 1998, 45–55) (Figure 6). This is very important, as it not only supports the environmental evidence for urbanism, but also suggests that their diet did not have satisfactory amounts of vitamins D and C. This may have been a consequence of their carer's socio-economic status, or cultural practices such as swaddling, as most of the vitamin D needed comes from sunlight action upon the skin (Oxford Concise Medical Dictionary 2000, 703).

CONCLUSION

In conclusion, the statistical significance of the stress indicators seen in the adults included in the chosen cemeteries, the evidence for metabolic and infectious disease, and infant health, support the environmental evidence for Romano-British urban areas as being unsanitary and often squalid. This increased the levels of morbidity and mortality for its inhabitants and compromised their life-ways. Connections can be made between maternal and non-adult health and disease exposure, also the influence of the urban environment upon the human body.

This study has shown the usefulness of a biocultural approach in understanding health and disease in past human groups. It also highlights the need for a greater understanding of the connections between different



Figure 6. Infant examples of periostitis and porotic hyperstosis. Top, occipital angle of the parietal. Middle, lateral aspect of the right tibia. Lower, anterior aspect of the right tibia. All bones from Poundbury. (based on Author's image. Drawn by V. Glue).

archaeological datasets, and the makeup of Romano-British urban communities, so that disease transmission and exposure within the Empire can be fully appreciated and understood.

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